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Creating sources of inspiration through eCollage, the FEA model, and a future visioning concept design project

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Abstract
This article presents an approach to creating sources of inspiration through a collaborative concept design that was developed and observed during a future visioning concept design project concerning the theme of "performance wear," which was conducted at the University of Helsinki for second-year textile student teachers. During the project, the students created future scenarios; used the functional, expressive, and aesthetic (FEA) consumer needs model for apparel design (Lamb and Kallal in Cloth Text Res J 10(2):42–47, 1992) when considering what performance wear could be like in a future scenario; and created digital collages (eCollages) to present their concepts. In the course that followed the concept design project, the students designed and made actual clothes using the concepts developed during the concept design project as one of their sources of inspiration. The outcomes of the process are described in this article through four research questions: (1) What type of future scenarios did the teams create, what types of eCollages did the teams make, and how did the teams use information and communication technologies (ICT) in their collages? (2) How did the use of eCollages enrich the concept presentations? (3) How were the three dimensions of the FEA model utilized and presented in the eCollages and team presentations? (4) How did the future visions of the concepts and the eCollages act as sources of inspiration in the students' clothing designs? Five of the six teams studied created a global future scenario that envisioned the world as a dystopia. The high level of technical and visual executions of all the eCollages was surprising. The ECollages played an important role in every team presentation and enriched them considerably. The FEA model, on the other hand, both provided a supporting framework for the concepts and guided the students to direct their attention to apparel within their future scenarios, as well as to consider different dimensions of it. The concepts especially inspired students to create aesthetic elements to their design and to consider the expressiveness and functionality of the garments from the concept's perspective. The students also challenged themselves to find technical solutions to design ideas they created through being inspired by the concepts. Furthermore, the students often described gaining inspiration from the story or atmosphere of the concept or other non-visual elements of it, and thereby it seems that our approach indeed succeeded in promoting multi-sensory inspiration.

Keywords Inspiration sources · Inspiration · Collaborative design: idea generation · Knowledge creation · Digital design methods · Clothing design · FEA model · eCollage

Extended author information available on the last page of the article

Introduction

This article describes the outcomes of a future visioning concept design project held at the University of Helsinki for second-year textile teacher students during the autumn term of 2016. During the project, whose theme was performance wear, the students created a future scenario and envisaged what the performance wear in that scenario would be like. As part of the concept design project, the students were required to prepare digital collages (eCollages) of their concepts, without prior technical training in making this type of collage; this created an additional challenge for the participants. Moreover, the students were required to follow the functional, expressive, and aesthetic (FEA) consumer needs model for apparel design, which required that the students consider the dimensions of functionality, expressiveness, and aesthetics in their designs (Lamb and Kallal 1992). This project was a catalyst for actual clothing design and creation, which occurred during a Spring 2017 course entitled "Clothing in Movement."

Previous studies concerning sources of inspiration in the design processes have mainly concentrated on the different types of sources of inspiration, the role of sources of inspiration in design processes, and how designers gather and use sources of inspiration (Eckert and Stacey 2000; Laamanen and Seitamaa-Hakkarainen 2009; Petre et al. 2006). Furthermore, the ideation and design processes of novice designers, such as students, have been studied intensively (Lahti et al. 2016). Similarly, previous studies concerning the use of digital tools in the early stages of the design process have been limited to investigations of how designers search for and store sources of inspiration, namely pictures, from the Internet (e.g. Gonçalves et al. 2016; Mougenot et al. 2008). In addition, previous research has focused on developing software and mobile applications specifically to store, arrange, and share, primarily visual, sources of inspiration (e.g. Keller et al. 2009). However, research on how to support the processes of producing and gathering sources of inspiration to trigger and guide ideation processes, especially in collaborative design in the digital age, is very limited. The need for this research emerges from this research gap. The aim of this study was to develop digital design methods that encourage novice designers to gather and use manifold, multi-sensory sources of inspiration that guide such designers to consider their design from several points of view (cf. Eckert et al. 2000; Gonçalves et al. 2014).

Although similar concept design projects within the field of craft teacher education have been carried out (2013–2015), the current project has two significant differences. One, it was arranged as a separate course to the actual clothing design course. Instead of traditional collages, eCollages were used as the visual presentation method, and this method was expected to enrich the visual presentations. Second, rather than provide students with specific tools or patterns to follow, this study encouraged students to explore new technological solutions and digital tools. Learning to use certain computer programs or to carry out specific tasks using ICT, without a direct connection to practice, does not necessarily promote the innovative use of technology or an ability to keep up with the vastly evolving opportunities offered by ICT. In this project, the view was that it is more beneficial for the students—the future teachers—to learn how to find and implement new technology and to gain the courage and self-assurance to do so (cf. Claxton 2002). Hence, the purpose of the project was threefold: to promote knowledge creation and thus extend their knowledge and skills in craft design and theory; to offer a rich selection of sources of inspiration on which to base actual clothing design tasks following the concept design project; and to introduce the students to design methods and creative practices that they could use in their future work as craft teachers.

The focus of this study was on eCollages and how the teams used them in their concept presentations. Furthermore, analyses were conducted on how the FEA model was utilized and represented in the eCollages and team presentations held at the final meeting of the course. The final part of the analyses concerned how the students actually used the concepts and eCollages as sources of inspiration for their individual clothing designs. The study was guided by four research questions: (1) What type of future scenarios did the teams consider, what types of eCollages did the teams make, and how did the teams use ICT in their collages? (2) How did the use of eCollages enrich the concept presentations? (3) How were the three dimensions of the FEA model utilized and presented in the eCollages and team presentations? (4) How did the future visions of the concepts and the eCollages act as sources of inspiration in the students' clothing designs? The following chapters present the theoretical aspects of the research and describe the project, its research aims, and its methods. Finally, the results are presented, and the significance of the findings is discussed.

Theoretical basis

Sources of inspiration as triggering forces for creative design processes

Craft design processes, as well as other creative design processes, can be described as iterative and cycling processes, in which different phases of the process—ideation, experimentation, reflection, and modification—mix and repeat until a desired design is achieved (Goel 1995; Lawson 2004; Seitamaa-Hakkarainen et al. 2001). Finding and utilizing sources of inspiration are essential to creative design (Eckert and Stacey 2000). Sources of inspiration generate ideas, which provide a basis for the entire process (Petre et al. 2006), and help a designer to find design ideas, develop those ideas, and move from the first vague mental image of an artefact to the final design (e.g. Laamanen and Seitamaa-Hakkarainen 2009). Sources of inspiration both expand the design space and direct the design process (Eckert et al. 2000). In idea generation, sources of inspiration have multiple purposes: they create a context for design; provide information; offer a basis and source for product features or details; and help designers to visualize and explain their ideas (Petre et al. 2006).

Almost anything—objects, images, memories, and abstractions—can be a source of inspiration (Petre et al. 2006). Professional designers constantly collect and arrange possible sources of inspiration (Eckert and Stacey 2000; Petre et al. 2006). According to Eckert et al. (2000), new designs emerge from designers being exposed to a wide range of potential sources of inspiration. Although designs are usually based on existing solutions (Lawson 2004), the most innovative design ideas often emerge from sources of inspiration that are not directly related to the design problem (Perttula and Sipilä 2007). Using common examples as sources of inspiration, such as pictures of jackets as sources of inspiration for a jacket design, on the other hand, has been found to promote design fixation and the creation of conventional designs (e.g. Jansson and Smith 1991; Perttula and Sipilä 2007).

In this project, the design process leads to the creation of actual clothes, but by keeping the concept design phase separate from the actual product design, the students had the opportunity to collaboratively explore clothing as a phenomenon, rather than concentrate on designing and making specific clothes. This potentially helps them to create more innovative solutions than by simply designing actual clothes directly without the concept design phase. In addition, this design approach potentially directs students to use a wide

variety of sources of inspiration in their designs, instead of only visual representations, which students often prefer (Gonçalves et al. 2014).

The future visioning concept design

Concept design can be defined in various ways, depending on context. Often, in product design, concept development initiates a design process and is considered to be the most significant phase of the innovative, so-called, fuzzy front-end of the process (Aspelund 2006). Concept design can also be defined as transformation design that begins before a design brief is set. Transformation is defined through six characteristics: "1. defining and redefining the brief, 2. collaborating between disciplines, 3. employing participatory design techniques, 4. building capacity, not dependency, 5. designing beyond traditional solutions and 6. creating fundamental change" (Rosted et al. 2007).

Concept design is typically future oriented. In industrial design, concepts are divided into four categories, depending on how far in the future the concept's focus is. The first two categories—solving (0–2 years) and defining (2–5 years) concepts—are typically directly related to product design. Two later categories—emerging (5–10 years) and visioning (more than 10 years) concepts–on the other hand, aim to explore future products and consumer needs in various future scenarios through models, narratives, and visualizations. This type of concept design is not constrained by, for example, existing manufacturing techniques or current consumer needs. Future visioning concept design produces new, even radical, ideas and promotes designers' innovativeness (Keinonen 2006; Perttula and Sääskilahti 2004; Sääskilahti et al. 2005).

Future visioning concept design seeks to describe the principles of design solutions for possible future products, without actually defining the products. Instead, the concept contains an idea that determines how different aspects of the concept join together into a uniform whole (Aspelund 2006). The future visioning concept design project has been developed to provide students with "out-of-the-box" sources of inspiration and ideas to promote innovativeness and to help students in the actual clothing design phase. The concept development potentially functions as a supported way to collect and arrange sources of inspiration, thus mimicking the practices of professional designers (cf. Eckert and Stacey 2000; Petre et al. 2006), and helps the students to define design principles for the actual clothes, which will be designed at a later stage of the project.

FEA consumer needs model

To further guide the students to explore clothing from diverse perspectives, the FEA consumer needs model for apparel design (Fig. 1) was incorporated into the project (see Lamb and Kallal 1992). The FEA model forms a framework for user-centered apparel design. It divides consumer needs for apparel into three, partially interlinked, dimensions that should all be taken into consideration during a design process: functional, expressive, and aesthetic. "Functional" refers to aspects that relate to a garment's utility, such as fit and comfort. 'Expressiveness' describes the communicative and symbolic aspects that a garment represents, such as self-expression and values. "Aesthetic" relates to issues of beauty and art, such as shape, color, and texture. The FEA model emphasizes the importance of acknowledging the cultural context of the target users and how this context affects all three dimensions of the model. The FEA model helps designers to analyze design problems, to

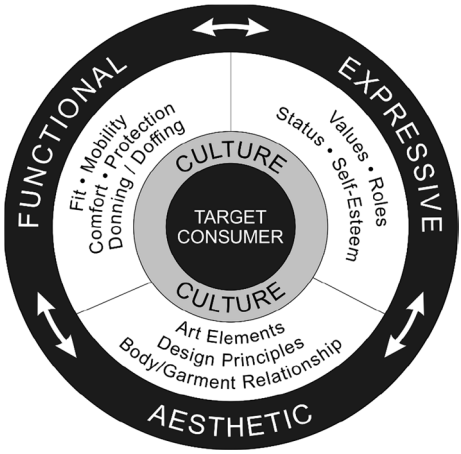


Fig. 1 The FEA consumer needs model (Lamb and Kallal 1992)

generate design ideas, and to evaluate designs. It can be utilized at any stage of the design process, or afterwards, as an assessment tool for any garment design.

Originally, the FEA model was developed to guide students, who design clothing for people with special needs, to adopt a more holistic approach to apparel design, rather than just consider the functional aspects of the clothing (Lamb and Kallal 1992). The model has been used for this purpose, and to design clothing for specific activities, in many studies (e.g. Bye and Hakala 2005; Chae and Evenson 2014; Stokes and Black 2012). Furthermore, the FEA model has been utilized to create frameworks for sustainable fashion design and consumption (e.g. Hur et al. 2013; Jin Gam et al. 2009). Instead of using the model as a design method, it has been also used as a research framework to analyze apparel design from different perspectives (e.g. Lahti and Seitamaa-Hakkarainen 2005). Thus far, the FEA model has been mainly used in the later stages of the design process to evaluate the design or design-specific features. However, due to its adaptability to manifold design processes, it was adapted into the project to guide students' attention to apparel within their concepts.

Creating knowledge through design

Through future visioning concept design, the aim was to promote collaborative knowledge creation rather than to transmit pre-given content knowledge and routine procedures to the students. In this study, knowledge creation is considered a collaborative, practical, artifact-mediated activity in which students engage in creative processes through which they build, share, and cultivate new knowledge (e.g. Paavola and Hakkarainen 2014; Sawyer 2006; Scardamalia and Bereiter 2014a).

Artifact-mediated knowledge creation can be considered as parallel to the creative design processes. It is an emergent and nonlinear process whereby the actual goals, stages, flow of creative activity, digital instruments, or end results cannot be pre-determined (Scardamalia and Bereiter 2014b). Knowledge creation relies on the collaboration of people who actively engage in the process, take responsibility of the process, and focus on a shared design object—an epistemic object that is not only the artifact being designed but also an abstract object of shared knowledge—that they jointly construct during the design process (e.g. Ewenstein and Whyte 2009; Knorr-Cetina 2001; Paavola and Hakkarainen 2014; Sawyer 2006; Scardamalia and Bereiter 2014a).

The project was designed to contain several elements that potentially promote knowledge creation. The future scenario building phase guided students to explore the current environment and through that envision the future and innovate new technologies and products. The eCollaging and presentation design, on the other hand, engaged the students in collaborative efforts to create knowledge concerning the technical possibilities of presenting multi-sensory information. The students had the opportunity to innovate how to use technologies creatively, in unconventional ways, instead of learning pre-given procedures. Finally, the actual clothing design phase gave the students the opportunity to examine and innovate how they could express different aspects of the concepts in clothing through textile materials and craft techniques.

Research method

Participants and the project assignment

Twenty-one second-year craft teacher students, 1 male and 20 females, approximately between the ages of 20 and 40, participated in the project. None had previous experience with this type of future visioning concept design nor with creating eCollages. However, some of the participants had skills that they could utilize in creating eCollages, such as Photoshop or video editing expertise. There were 6 teams of 3–4 people who collaborated on the concept development. The project was carried out over a period of 4 weeks, starting with an opening lecture in which students were given the concept design task, introduced to the theoretical aspects of concept development, and given practical instructions for the project. During the first 2 weeks, all teams had 2 four-hour supervised sessions in which they could work with their own concepts and receive individual tutoring. Most of the work the teams conducted was without supervision by meeting face-to-face or over the Internet.

The project assignment was formed around the theory of systematic visionary concept development (see Keinonen 2006; Perttula and Sääskilahti 2004; Sääskilahti et al. 2005). The key aspects of the project briefing were as follows:

- The aim of the project is to develop a visionary concept around the theme of "performance wear."
- The concept description must contain the following: a written description of the concept and the idea behind it, a visual, digital collage-type presentation (eCollage), and material experiments.
- The team must prepare a 15-min presentation of the concept to be delivered at the final meeting of the project.
- The presentation and all three parts of the concept must form a uniform whole.

The teams were asked to vision a future scenario and determine what performance wear could be like. To help the visioning process, the teams were provided with a futures table (Fig. 2) that they were encouraged to use as a starting point for building the scenario (cf. Perttula and Sääskilahti 2004). The teams were specifically instructed to concentrate on the emerging and visioning concept categories (outlined in red in Fig. 2). The teams were also instructed to use Lamb and Kallal's (1992) FEA consumer needs model for apparel design (see Fig. 1) when considering the options for performance wear in their future scenario.

	Solving concepts	Defining concepts	Emerging concepts	Visioning concepts
Timeline	**0-2 years**	**2-5 years**	**5-10 years**	**> 10 years**
What is not yet available or existing?				
What is emerging?				
What is applicable?				
What is available?				
What is not available anymore?				

Fig. 2 Futures table (cf. Perttula and Sääskilahti 2004)

The students were not given any specific technological instructions on how to create eCollages. However, discussions were conducted with them regarding the issues to consider in eCollage design, such as how to exhibit movement, atmosphere, touch, and feeling in a digital format. The students were also given examples of online services[1] and some tips on possible elements (e.g. pictures, videos, and sounds) that they could use in their eCollage design. Furthermore, the students received elaboration on the new possibilities that using a digital format could bring to material experiments. For example, by using videos, it is possible to make and represent material experiments in which the key idea is how the material behaves in certain conditions or where the material is destroyed.

More specific instructions were given regarding written descriptions of the concepts. These were to be written in the form of an article containing references to at least two written sources of information and including at least one visual image that provides additional information about the concept. The text was to be no longer than one A4 page. In addition to the written description and eCollage, the teams were required to make and represent material experiments. These had to link directly to the concept and be carried out by the team members during the project. The students were encouraged to devise ways to link the eCollage and material experiments to form a uniform whole.

After the concept design phase, the students designed their own clothing during a separate course in Spring 2017 entitled "Clothing in Movement." They were asked to use a concept as one of the bases of their designs. They could choose to use their own team's concept or any of the other concepts. Their task was to design and later make two pieces of clothing: a knitted top and a pair of pants made of the fabric of their choice. Overall, 13 of the students gave permission to video record their clothing design presentations and to use the presented slides.

Research aims

In this article, the outcomes of the future visioning concept design process are described through four research questions:

[1] https://www.behance.net/, https://carbonmade.com/, http://dropr.com/, https://www.weebly.com/, http://www.wix.com/, https://wordpress.com/.

Table 1 Video data of the teams' concept presentations and individual students' clothing design presentations in mm:ss

	Number of the team (see Table 2 for concept descriptions)					
	1	2	3	4	5	6
Concept presentation	26:27	21:25	17:16	14:39	17:29	30:24
Clothing design presentations		3:17			4:14	5:36
		6:28			5:26	3:47
		7:35			4:25	3:41
		7:24			5:04	6:44
Total		24:44			19:09	19:48

1. What type of future scenarios did the teams consider, what types of eCollages did the teams make, and how did the teams use ICT in their collages?
2. How did the use of eCollages enrich the concept presentations?
3. How were the three dimensions of the FEA model utilized and presented in the eCollages and team presentations?
4. How did the future visions of the concepts and the eCollages act as sources of inspiration in the students' clothing designs?

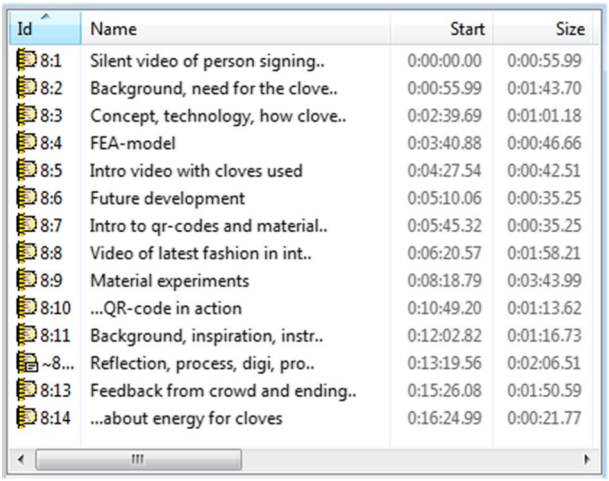
Collected data and methods of data analysis

Four sets of data were collected and analyzed: the teams' eCollages, the teams' written descriptions of the concepts, video data of the team presentations, and video data of the individual students' clothing design presentations. The video data sets are presented in detail in Table 1. The clothing design presentations were recorded only for the students that had been given permission to do so. Therefore, only the concepts made by teams 2, 5, and 6 were analyzed from the perspective of how they acted as sources of inspiration in students' clothing designs.

The eCollages were analyzed by writing descriptions of the visual and digital design solutions that were used in them as well as how the eCollages were linked to other elements of the concept presentations. The written descriptions were used as supporting data to help in-depth analysis. The writings provided insight into what the teams were seeking to present as their key ideas of the concepts.

The video data were analyzed using Atlas.ti[2] software (versions 7.5.16 to 8.30.20). The team presentation videos were prepared for analysis by forming a Clickable Table of Contents (C-TOC) of each video (see Hauptmann 2005). (An example of a C-TOC is presented in Fig. 3.) The videos were then analyzed as raw data by writing descriptions and coding those parts of the data from the C-TOCs that were applicable to the interest areas of this part of the research project. During the coding process, further segmentation of the data was performed using thematic criteria. The coding was done using predetermined codes for actions and speech, which were related to the dimensions of the FEA model (i.e. functional, expressive, and aesthetic). The first analysis stage reduced the video data

[2] http://atlasti.com/.



Id	Name	Start	Size
8:1	Silent video of person signing..	0:00:00.00	0:00:55.99
8:2	Background, need for the clove..	0:00:55.99	0:01:43.70
8:3	Concept, technology, how clove..	0:02:39.69	0:01:01.18
8:4	FEA-model	0:03:40.88	0:00:46.66
8:5	Intro video with cloves used	0:04:27.54	0:00:42.51
8:6	Future development	0:05:10.06	0:00:35.25
8:7	Intro to qr-codes and material..	0:05:45.32	0:00:35.25
8:8	Video of latest fashion in int..	0:06:20.57	0:01:58.21
8:9	Material experiments	0:08:18.79	0:03:43.99
8:10	...QR-code in action	0:10:49.20	0:01:13.62
8:11	Background, inspiration, instr..	0:12:02.82	0:01:16.73
~8...	Reflection, process, digi, pro..	0:13:19.56	0:02:06.51
8:13	Feedback from crowd and ending..	0:15:26.08	0:01:50.59
8:14	...about energy for cloves	0:16:24.99	0:00:21.77

Fig. 3 Example of a C-TOC of a videoed team presentation

into (1) descriptions of eCollages, (2) descriptions of design processes and methods, and (3) descriptions of utilizations of the FEA model that were then further analyzed directly from the raw video data. The video data of individual students' clothing design presentations was analyzed by first locating the parts of the data where the students described being either inspired by the concepts or deriving ideas from those. These parts were then coded by using two pre-determined coding categories: (1) the dimensions of the FEA model (functional, expressive, aesthetic) and (2) the part of the concept that promoted the inspiration or idea (eCollage, story of the concept, presentation).

Findings

The findings of this study will be presented in three parts: the future scenarios and eCollages the student teams created, the FEA model applications to the concept presentations, and the eCollages. Finally, it will be described how the future visions and the eCollages acted as sources of inspiration in the students' clothing designs.

Future scenarios and eCollages

Five teams created a global future scenario, and one team concentrated on the future applications provided by their imaginary "smart glove" for people with disabilities. All the teams that created global future scenarios ended up with very similar visions of the future world as a dystopia. How they utilized this future vision in their concepts, however, varied. The future scenarios, timelines, and key ideas of the concepts are presented in Table 2. The names of the concepts are translated from Finnish.

All six teams were able to make eCollages with either no or very minimal technical assistance. Every team used a different tool to create their eCollages. Also, the styles, multimedia elements, and use of the eCollages within the team presentations varied. Three teams (1, 4, and 6) created eCollages that were based on separate scenes of individual photos or photo-collages using PowerPoint and horizontally scrollable website layouts. They used the eCollages as story illustrations, in which the scenes were related to individual

Table 2 Future scenarios, timelines, and key ideas of the teams' concepts

Team 1	Desolated
Timeline	Far in the future
Future scenario	The rotation of planet has almost stopped and therefore conditions on Earth have changed to extremely hot, desert-like, in some areas and, to extremely cold, arctic, in others
Concept's key idea	Visions how people could live and survive in such extremely hot and cold conditions, especially from perspective of clothing
Team 2	When the world is not enough
Timeline	Far in the future
Future scenario	Urbanization continues and finally reaches a breaking point where society breaks down
Concept's key idea	Beehive metaphor. What happens when the hive becomes overcrowded, the queen leaves or dies and the hive breaks? Will it lead to serenity and peace?
Team 3	Communicative gloves
Timeline	> 5 years, relatively near future
Future scenario	How people with disabilities, especially those with hearing defects, can express themselves better and live more easily and independently by using the team's imaginary glove, which includes various smart technologies
Concept's key idea	A glove that helps people with disabilities in their everyday activities and enables them to express themselves independently
Team 4	Wanderers of utopy
Timeline	2156
Future scenario	It is five years since the 20-year long World War III ended. The cities of the world are ruined. A group of people has been able to create a utopia where people live in peace and harmony with each other and nature. However, they are constantly threatened by the "bad guys"
Concept's key idea	Visions: how the group dresses and makes clothes using recycled materials; how they express their values and belonging to the "tribe" through apparel; how the clothing protects the group
Team 5	Green planet
Timeline	Far in the future
Future scenario	Urbanization has continued, and natural resources have diminished significantly. People live hectic lives in restless cities. They eat processed food, dress in synthetic clothes, and rarely see pure green nature
Concept's key idea	A luxury holiday trip to a faraway green planet, where visitors can relax and enjoy the sense of weightlessness, protected by a glass bubble. They can eat pure, natural food, dress in clothes made of natural fibers (on top of protective hi-tech underwear), surrounded by a magical and relaxing scene of travelling through a magnetic storm in space
Team 6	Atlantis
Timeline	2065
Future scenario	Climate change has led to rising sea levels and made conditions on the planet often harsh and unpredictable

Table 2 (continued)

Team 6	Atlantis
Concept's key idea	Moveable artificial islands have become popular holiday destinations for wealthy people. The concept paints a scenario of the crowd being on a senior group package tour to the moveable island "Atlantis." On Atlantis, the group can return to the beginning of the twenty-first century and enjoy all the hedonistic pleasures that were available back then

Fig. 4 First scene of team 4's eCollage: Wanderers of utopy

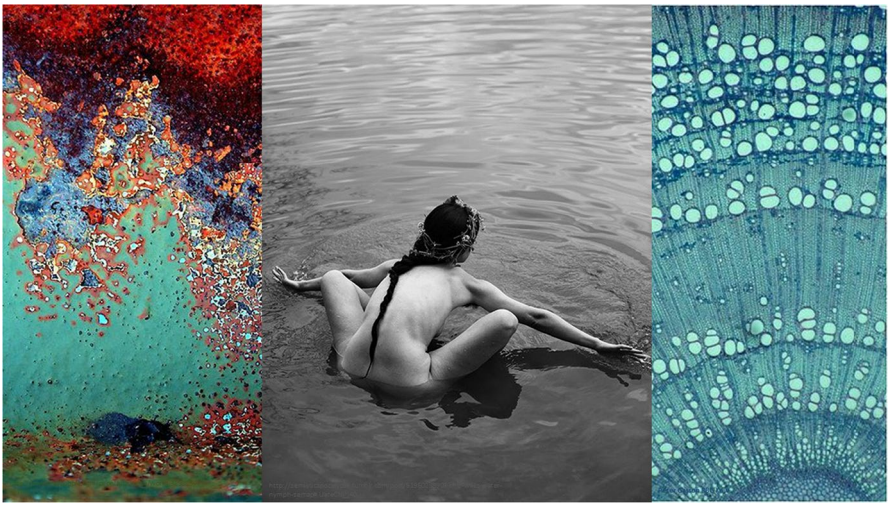


Fig. 5 Second scene of team 4's eCollage: Wanderers of utopy

parts of their concept presentations. Teams 1 and 6 further enriched their team presentation

Fig. 6 Third scene of team 4's eCollage: Wanderers of utopy

with music and sound-effects, such as the sounds of wind or waves. Team 4's eCollage scenes are presented in Figs. 4, 5 and 6.

Team 5 created a vertically scrollable website that had an animated background that mimicked a view of moving through space. Their collage also had scene-type elements, but their main use of the eCollage was not to carry the concept presentation from scene to scene. Instead, they used the eCollage, above all, to create an atmosphere and feeling of being in space on their imaginary green planet. They also used sound-effects to further expand their presentation. Team 3, the only team that did not envision a global-scale future scenario, created an online poster (Fig. 7) that included video elements directly embedded in it. The poster was designed to look like it could be used to advertise the product, which contributed to the theme of the presentation that resembled a marketing event. They used QR codes to give the audience an opportunity to use their smartphones to experiment with how the product could function. Finally, Team 2 created their eCollage using Photoshop and presented it as an individual element of their presentation. Their eCollage was an animated video in which the first scene represented their future dystopia vision. The first scene then began to crack and finally shattered to reveal a "new world of peace and harmony." Sound-effects were used to further intensify the scenes; for example, at the breaking point there was the beep of a hospital life support machine when the heart stops.

FEA model applications to the concept presentations and eCollages

A uniform pattern emerged from the data analyses of how the teams applied the three dimensions of the FEA model to their concepts (Lamb and Kallal 1992). All teams used the model in the same manner. They strongly emphasized one dimension of the model and built their concept and presentation around that. A second dimension was used as a subsidiary element that was clearly presented through at least one component of the concept presentation but was still overshadowed by the primary dimension. The third dimension seemed to be almost incidental to the process of all teams. The order of the three dimensions within the hierarchy varied between the concepts although the theme of the design

Fig. 7 Team 3's eCollage

Table 3 The use of elements of the FEA model in concept presentations and eCollages

Team	Primary dimension	Subsidiary dimension	Incidental dimension	Primary dimension of the eCollage
1	Functional	Expressive	Aesthetic	Functional
2	Aesthetic	Expressive	Functional	Expressive
3	Expressive	Functional	Aesthetic	Expressive
4	Expressive	Aesthetic	Functional	Expressive
5	Aesthetic	Functional	Expressive	Aesthetic
6	Aesthetic	Functional	Expressive	Aesthetic

project was "performance wear," which could have promoted functionality over aesthetics and expressiveness. In five eCollages, the primary FEA model dimension was in the most significant role. Primary, subsidiary, and incidental dimensions in concept presentations, as well as primary dimensions of the eCollages, are presented in Table 3.

The most variation in the hierarchic pattern of using the FEA model occurred in how the teams handled the incidental dimension. Some teams mentioned it more often than others during their presentations, but even these teams did not specify precisely how that dimension actually related to the key idea of their concept.

Future visions and eCollages as sources of inspiration

To determine how the stories of the concepts, i.e. the future scenarios, and the eCollages acted as sources of inspiration, presentations of clothing designs based on three of the concepts were analyzed: *When the world is not enough* (team 2), *Green planet* (team 5), and *Atlantis* (team 6). Four videoed presentations from each team were analyzed. In the following, each of the concepts will be handled individually and how they acted as sources of inspiration for the students will be described.

Team 2's concept, *When the world is not enough*, made an unforgettable impression on the four students who presented their clothing design ideas. The story itself, with its contrast between urbanization and anxiety and serenity, inspired all four students. Three of them described their design aims directly through the story and carried it further with their own interpretations.

> Anna: "For me this started from the story: from urbanization through destruction to serenity. My view point was not on the global urbanization but on the personal rush of your own mind."
> Mia: "When you are in a point that the rush becomes unbearable and you kind of break down—that transition there, between the breaking point and serenity, how can you convey that and make it visible in a product?"

The story intertwined with the animated eCollage, which was further intensified with sound effects, and this acted as an inspiration for both the aesthetic and expressive elements in the designs, such as color schemes, structures, and material choices. The beehive metaphor transferred into knitted surfaces and embroidered details. The cracking transformation from rush to serenity was a powerful element of the eCollage that produced many ideas and experimentations. Julia, for example, explored the possibilities to transfer the cracking as well as the ruthless and straining environment of the concept into a color scheme, knitted surfaces, and sewn structures (Figs. 8).

Mia, on the other hand, carried her initial idea of conveying the transition between the breaking point and serenity in her sketches (Fig. 9). She transformed the urbanization and anxiety into a harness metaphor that she represented with a heavy plain knit surface on the bodice of her jumper as well as with metal chains between the knit. To visualize the breaking point and transformation to serenity, she used laze knit on the yoke and sleeves. The ruffling on the sleeves was inspired by a picture of a volcanic eruption in the team's eCollage.

In their presentations, the students described their inspiration in a multi-sensory way by talking about the whole concept, the animated cracking transformation and atmosphere created by the presentation, rather than just individual pictures or scenes from the eCollage. Overall, the same pattern regarding the FEA model elements emerged from usage of the concept and eCollage as a source of inspiration. The concept of *When the world is not enough* was only described as a source of inspiration with the aesthetic and expressive elements of the students' designs.

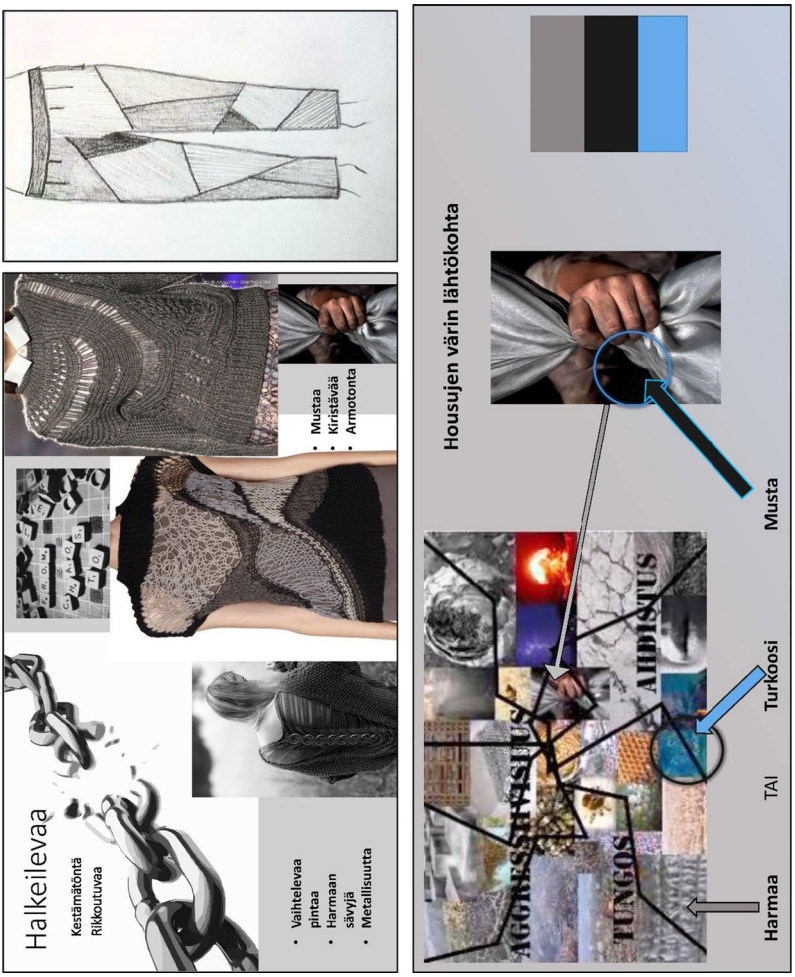
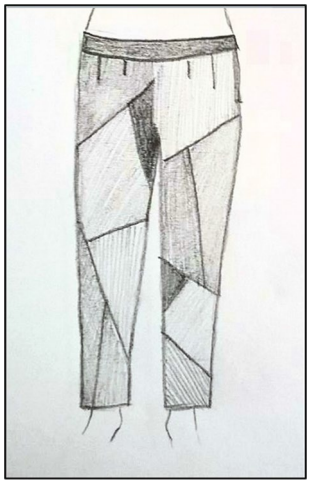


Fig. 8 Julia's mood board, sketch, and color scheme

Fig. 9 Mia's sketches



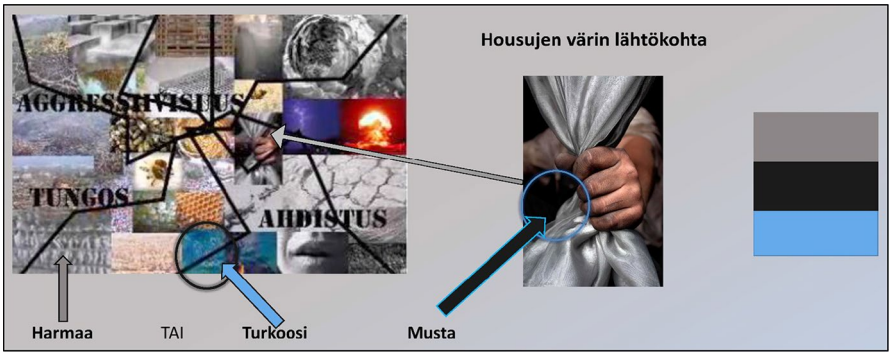


Fig. 10 Part of Eva's presentation slide about knitted surfaces and materials

The *Green planet* concept, which followed the same pattern of FEA model usage as the concept of *When the world is not enough*, inspired the students mainly in the aesthetic aspects of their design, as well as in some functional elements. From the aesthetic point of view, the moving background of the eCollage and the sound effects embedded into it, which made the viewers feel like they were flying through space, provided inspiration for many aesthetic elements in the designs. For example, in Eva's design ideas (Fig. 10) this inspiration transformed into knitted surfaces, where the yellow color represented the sun, and the three-dimensional surface reflected the surface of an asteroid or a planet. The fabric, on the other hand, reminded her of the night sky with stars.

The space environment and, through that, the feeling of peaceful weightlessness also inspired the students to create light weight and flowy designs. In addition, the story and the atmosphere of the concept inspired the students in their material choices, either towards usage of natural materials that were present in the imaginary green planet or by getting them to seek materials that reflected the aesthetics of space. In the story, people travelled from the city through space to a distant, untouched planet. This journey in itself also acted as a source of inspiration:

Fig. 11 Elsa's sketch of flowy pants

> Jessica: "We had this 'natural materials' theme in our concept in that you travel to the nature from the city. So, my design process started to transform like that—from the hard city to more natural."

Finally, team 6's *Atlantis* concept provided both aesthetic and functional inspiration to the students, again following the same pattern that emerged from the FEA model usage in the eCollages. The activities on the imaginary land, such as golf, dancing, and fishing, as well as travelling, were especially inspiring to the students. Travelling directed their thoughts towards designing clothes that were versatile and comfortable to wear. In many designs, the different aspects of the concept were incorporated in one design idea. For example, in her idea of flowy pants (Fig. 11), Elsa combined the paradise island's atmosphere with activities of flying and dancing, which require comfortable clothes in which one can move freely.

Many images from their eCollage, such as the images of fishnet and golf courses, as well as the material experiments they performed, inspired the students to ideate how the aesthetics of those images and experiments could be transformed into a knitted surface.

> Leah: "In our fishnet-themed material experiment, we had this metallic thread. I thought, 'Could there be details in my knit where I could use some sort of metal foil?'"

Furthermore, fishing, colorful food, the sea, and the scenery of the paradise island, which were transmitted through the eCollage and material experiments, acted as a strong source

of inspiration to the students' color choices, which were bright colors such as shades of blue and turquoise.

Conclusions and discussion

The purpose of this research was to describe the outcomes of the future visioning concept design process by answering four questions: (1) What type of future scenarios did the teams consider, what types of eCollages did the teams make, and how did the teams use ICT in their collages? (2) How did the use of eCollages enrich the concept presentations? (3) How were the three dimensions of the FEA model utilized and presented in the eCollages and team presentations? (4) How did the future visions of the concepts and the eCollages act as sources of inspiration in the students' clothing designs? The results suggest that, at least in design-oriented higher education, open-ended design tasks that use future visioning concept design, the digital eCollage presentation format, and the FEA model to create sources of inspiration can be successfully conducted without providing students with prior technical training.

The future visioning concept design and the usage of the futures table gave the students an opportunity to distance themselves from the current fashion, consumer needs, and available technologies (cf. Perttula and Sipilä 2007). The FEA model both provided a supporting framework for the concepts and guided the students to direct their attention to apparel within their future scenarios, as well as to consider different dimensions of it. Through this approach, the students were able to define design principles for performance wear at the conceptual level, without actually defining the garments and thereby avoiding the use of common examples as their sources of inspiration (cf. Aspelund 2006; Jansson and Smith 1991; Perttula and Sipilä 2007). Creating eCollages, on the other hand, offered the students ample opportunities to learn and develop new digital presentation methods. In addition, the eCollages also provided more multi-sensory way of presenting the concepts, compared to traditional paper collages (cf. Gonçalves et al. 2014).

The high level of technical and visual executions of all the eCollages analyzed in this study was surprising. Such diversity of different digital tools to be used in creating the eCollages or the creative and innovative use of them was not expected. It seems that the students were truly able to create shared knowledge of digital representation methods (cf. Paavola and Hakkarainen 2014; Sawyer 2006; Scardamalia and Bereiter 2014a). That also raises the question of how the eCollages would have turned out if the students had been given prior training in using specific digital tools? Instead of the more advanced and high-quality executions that were observed, the outcome could have been six eCollages that would have closely resembled each other, both in terms of the technical and visual aspects of the design. Could such eCollages offer students the same possibilities for collaborative learning and knowledge-creation, as well as such a wide variety of design ideas and sources of inspiration?

The results suggest that the eCollages played an important role in every team presentation and enriched them significantly. Without the eCollages, the presentations would have lacked significantly in visual and acoustic effectiveness. The size of the on-screen eCollages on screen, compared to the concrete collages, which were limited to the size of an A1 sheet, made the eCollages stand out more and offered possibilities to be used as effective backgrounds or as atmospheric elements. The ability to create individual scenes within

the eCollages also brought a new dimension to the presentations. While concrete collages are hung on a wall and therefore constantly visible to the audience, eCollages can contain elements that are present only during certain parts of the presentations. Furthermore, animations and videos introduced a possibility to embed stand-alone elements into a presentation that did not require verbal explanations and could still convey a strong message to the audience. The message was often further intensified by using sound-effects or music. These acoustic elements were especially effective in creating a certain atmosphere, a mental picture, or a feeling. Finally, the use of interactive addition, a QR code, gave the audience a chance to experiment with an imaginary future product. The findings of this study suggest that eCollaging is a useful addition to the methods of creating, finding, collecting, and sharing sources of inspiration and triggering idea generation.

The findings about how students utilized and represented the FEA model in their eCollages and team presentations were interesting. Every team used the model in the same hierarchic manner. They strongly emphasized one dimension of the model, a second dimension was used as a subsidiary element, and the third dimension seemed to be almost incidental to the processes of all the teams. Lamb and Kallal (1992) acknowledge that the dimensions of the model may be paired and/or applied in a relative hierarchy. On the other hand, in a previous study by Lahti and Seitamaa-Hakkarainen (2005) of collaborative design processes of conference bags, the participants strongly emphasized functionality over expressive and aesthetic aspects in their designs.

This hierarchy of the FEA model's dimensions also transferred to the actual clothing designs when the students used the concepts as their sources of inspiration. The concepts especially inspired students to create aesthetic elements to their design and to consider the expressiveness and functionality of the garments from the concept's perspective, instead of, for example, the students' daily life or common design principles of current fashion. The students also challenged themselves to find technical solutions to design ideas they created through being inspired by the concepts, such as how to express cracking or the aesthetics of space through a knitted surface. Furthermore, it must be noted that the students often described gaining inspiration from the story or atmosphere of the concept or other non-visual elements of it, and thereby it seems that our approach indeed succeeded in promoting multi-sensory inspiration.

The results of this qualitative study should be considered in the light of some limitations that raise needs for future research. In this study we investigated six student teams from University of Helsinki. To both further confirm our findings and to provide more insight into the similar processes and their potential applications we suggest future studies with larger and more diverse groups of participants. The hierarchical application of the FEA model's dimensions has not been demonstrated in previous studies. Therefore, further research is needed to determine if a hierarchical approach to the FEA model's dimensions is exclusive to this type of open-ended conceptual design only or can be applied to other types of design processes. Furthermore, future research is needed to determine if the hierarchical application of the FEA model applies to all stages of the design process. This study was conducted with adult textile student teachers, who can be considered relatively novice designers. Whether our findings also apply in the design processes of expert designers and, for example, when designing with children, are also interesting questions for future research.

New digital technologies are quickly transforming textile and apparel design and manufacturing, as well as the textiles themselves, such as through wearable computing (e-textiles). Furthermore, new methods and instruments of digital presentation and storytelling, such as virtual reality, are constantly emerging. To encourage the innovative use and

development of these new emerging technologies, it is essential to find approaches to textile and apparel design education that promote students' creativity and knowledge-creation competencies. The findings suggest that the approach to creating sources of inspiration presented in this article fosters these competencies.

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